

## CLAIMS

1. A dispensing system for accurately dispensing material onto a substrate, the system comprising:

5 a dispensing element having a metering device that controls a quantity of material dispensed from the dispensing element;

a positioning system coupled to the dispensing element to move the dispensing element over the substrate in a dispensing pattern;

10 a calibration device having a dish that receives material from the dispensing element during a calibration routine of the dispensing system; and

15 a controller, coupled to the positioning system, the dispensing element and the calibration device to control operation of the dispensing system, wherein the controller is constructed and arranged to control the positioning system and the dispensing element such that the dispensing element is moved and controlled according to a calibration pattern to dispense material into the dish during a calibration routine, and wherein the calibration pattern is representative of the dispensing pattern.

20 2. The system of claim 1, wherein the dish is removably connected to the calibration device.

3. The system of claim 1 wherein the dish further includes a tab for conveying the dish to or from the calibration device.

25 4. The system of claim 1, wherein the dish further includes a protuberance for operatively removing an amount of material from the dispensing element.

5. The system of claim 1, wherein the dish is disposable.

30 6. The system of claim 1, wherein the dish will withstand a temperature that will allow an amount of dispensed material collected in the dish to cure.

7. The system of claim 1, wherein the dish is fabricated from a generally conductive material.

5 8. The system of claim 1, wherein the calibration device is constructed and arranged to determine a quantity of material dispensed during a calibration routine, and wherein the quantity is compared with a target quantity of material to determine an error value.

10 9. The system of claim 8, wherein the controller is constructed and arranged to apply a scale factor to the dispensing pattern to obtain the calibration pattern.

15 10. The system of claim 9, wherein the scale factor is applied to the speed of movement of the dispensing system during a calibration routine such that the material dispensed during a calibration routine is substantially the same as that dispensed onto a substrate.

20 11. The system of claim 10, wherein the system is constructed and arranged to adjust a rate of delivery of the metering device when the error value is greater than a predefined value.

12. The system of claim 10, wherein the system is constructed to adjust a speed of movement of the pump when the error value is greater than a predefined value.

25 13. The system of claim 1, wherein the calibration pattern is the same as the dispensing pattern.

14. A method of calibrating a dispensing system that dispenses material onto a substrate according to a dispensing pattern, the dispensing system having a dispensing pump

that dispenses material and a gantry system that controls movement of the pump over the substrate and over a calibration system, the method comprising steps of:

(a) moving the pump over the calibration system;

(b) dispensing a quantity of material from the pump while the pump is moved by the gantry system according to a calibration pattern that is representative of the dispensing pattern;

(c) collecting the dispensing material in a dish;

(d) determining the quantity of material dispensed;

(e) comparing the quantity of material dispensed with a target quantity; and

(f) adjusting characteristics of the dispensing system when a difference between the quantity of material dispensed and the target quantity is greater than a predetermined tolerance.

15. The method of claim 14, wherein steps (b) through (f) are repeated prior to dispensing on a substrate until the difference is less than the tolerance.

16. The method of claim 14 or claim 15, wherein the dish is removed, disposed of and replaced after step (f).

17. The method of claim 16, wherein the material in the dish is cured prior to the dish being disposed of.

18. The method of claim 15, further comprising a step of applying a scaling factor to the predetermined pattern to reduce the distance traveled by the pump to maintain the pump over the calibration system during a calibration routine.

19. The method of claim 18, wherein the scaling factor is applied to the gantry system to reduce the speed of movement of the pump during a calibration routine such that the material dispensed during a calibration routine is substantially the same as that dispensed onto a substrate.

20. The method of claim 14, further comprising a step of applying a scaling factor to the predetermined pattern to reduce the distance traveled by the pump to maintain the pump over the calibration system during a calibration routine.

21. The method of claim 20, further comprising a step of applying the scaling factor to the gantry system to reduce the speed of movement of the pump during a calibration routine such that the material dispensed during a calibration routine is substantially the same as that dispensed onto a substrate.

22. A system for dispensing a material onto a substrate, the system comprising:  
a dispensing element having a metering device that controls a quantity of material dispensed from the dispensing element;

a positioning system coupled to the dispensing element to move the dispensing element over the substrate in a dispensing pattern;

a calibration device having a dish that receives material from the dispensing element during a calibration routine of the dispensing system;

means for moving the dispensing element according to a calibration pattern that is representative of the dispensing pattern to dispense material into the dish during the calibration routine; and

means for determining the quantity of material dispensed during the calibration routine.

23. The system of claim 22, further comprising:

means for determining a difference between the quantity of material dispensed with a target quantity; and

means for adjusting characteristics of the system to reduce the difference.

24. The system of claim 23, further comprising:  
means for applying a scaling factor to the system to reduce the distance traveled by the dispensing element during the calibration routine.

5 25. The system of claim 24, wherein the means for determining a quantity includes a weight scale for measuring the weight of material dispensed.

26. A method of calibrating a dispensing system that dispenses material onto a substrate according to a dispensing pattern, the dispensing system having a dispensing pump  
10 that dispenses material and a gantry system that controls movement of the pump over the substrate and over a calibration system having a dish, the method comprising steps of:

- (a) moving the pump over the dish of the calibration system;
- (b) pre-dispensing a quantity of material into the dish;
- (c) zeroing out the calibration system;
- 15 (d) dispensing a quantity of material from the pump while the pump is controlled to follow a calibration pattern that is representative of the dispensing pattern;
- (e) collecting the quantity of material dispensed from the pump during the calibration pattern in the dish;
- (f) measuring the amount of material collected in the dish during steps (d) and (e);
- 20 (g) comparing the amount of measured material in step (e) with a target quantity; and
- (h) adjusting characteristics of the dispensing system when a difference between the measured material and the target quantity is greater than a predetermined tolerance.

27. The method of claim 26, wherein steps (c) through (h) are repeated prior to  
25 dispensing on a substrate until the difference is less than the predetermined tolerance.

28. A method of calibrating a dispensing system that dispenses material onto a substrate according to a dispensing pattern, the dispensing system having a dispensing pump that dispenses material and a gantry system that controls movement of the pump over the  
30 substrate and over a calibration system, the calibration system having a dish for collecting a

quantity of dispensed material, the dish having a protuberance, the method comprising steps of:

(a) pre-dispensing a quantity of material from the dispensing system to create a tail of material;

5 (b) dislodging the tail of material from the dispensing system by moving the pump over the protuberance of the dish such that the tail of material contacts the protuberance;

(c) collecting the dislodged tail of material in the dish;

(d) zeroing the calibration system;

10 (e) dispensing a quantity of material from the pump while the pump is controlled to follow a dispensing calibration pattern that is representative of the dispensing pattern;

(f) collecting the dispensed quantity of material from the pump in the dish;

(g) dislodging a tail of material from the dispensing system by moving the pump over the protuberance of the dish such that the tail of material contacts the protuberance;

(h) collecting the dislodged tail of material in the dish;

15 (i) determining the quantity of material collected in the dish during steps (e) through (h);

(j) comparing the quantity of material dispensed with a target quantity; and

20 (k) adjusting characteristics of the dispensing system when a difference between the quantity of material dispensed and the target quantity is greater than a predetermined tolerance.

29. The method of claim 28, wherein steps (d) through (k) are repeated prior to dispensing on a substrate until the difference is less than the tolerance.